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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER
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CANTELMO, GREGG

ART UNIT	PAPER NUMBER
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1745

DATE MAILED: 08/30/2002

19

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/476,669

Applicant(s)

LAU, GORLEY L.

Examiner

Gregg Cantelmo

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 June 2002.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18 and 22-30 is/are pending in the application.
- 4a) Of the above claim(s) 24-29 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 12-18, 22 and 23 is/are allowed.
- 6) ☒ Claim(s) 1-11 and 30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 17.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Response to Amendment***

1. In response to the amendment received June 14 ,2002:
  - a. Claims 1-18 and 22-30 are pending. Claims 24-29 are withdrawn from consideration as previously established;
  - b. The 112 rejection is withdrawn in light of the amendment;
  - c. The prior art rejection is withdrawn in light of Applicant's response.

### ***Election/Restrictions***

2. This application contains claims 24-29 drawn to an invention nonelected in Paper No. 16 (item 3 of this paper, incorporated herein). A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

### ***Information Disclosure Statement***

3. The information submitted with a statement under 37 CFR 1.97(e) can be used in a new ground of rejection and the next Office action can be made final, if the new ground of rejection was necessitated by amendment of the application by applicant. Where the information is submitted during this period with a fee as set forth in 37 CFR 1.17(p), the examiner may use the information submitted, and make the next Office action final whether or not the claims have been amended, provided that no other new

Art Unit: 1745

ground of rejection which was not necessitated by amendment to the claims is introduced by the examiner. See MPEP § 706.07(a) and MPEP § 609 paragraph (B)(2). In this particular case, USPAT 5,985,759 (Kim) is being applied as the primary reference in the rejections below.

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

5. Claims 1, 3-7, 11 and 30 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. patent No. 5,985,759 (Kim).

Kim discloses a method for fabricating a metallization structure comprising: IMP depositing a wetting layer 26 (col. 7, ll. 13-15 and col. 8, ll. 38-42), applying a bias of 0-500 W to the substrate (Table 1, in particular the portion of Table 1 continued under column 13) and sputtering depositing a bulk metal layer on the wetting layer (col. 8, ll. 38-42). A portion of the range for the bias to the substrate is identical to the wafer bias

Art Unit: 1745

ranges applied in the instant application (see page 21, lines 25-29 for example).

Therefore the portion of the substrate bias in Kim which is identical to the bias applied to the substrate is held to be a bias which is sufficient to splash deposited metal at the bottom of the cavity to sidewalls of the cavity during IMP deposition of the wetting layer (as applied to claim 1).

The bulk layer is deposited to fill the cavity (col. 11, ll. 7-10 as applied to claim 3).

The wetting layer comprises titanium (Table I and col. 14, ll. 62-63 as applied to claim 4).

Kim shows that the substrate defines a lower portion of the microelectronic topography wherein the substrate is below the dielectric layer. The multiple titanium comprising layers act as a barrier layer as well as a wetting layer over the sidewalls and bottom of the contacts (as applied to claim 5).

The IMP depositing of the wetting layer comprises directing ionized metal atoms from a target toward the dielectric layer in a direction substantially perpendicular to the dielectric layer. The target power, coil power and substrate bias in Table I-continued on column 13 provide conditions which will direct the ionized metal atoms in this manner (as applied to claim 6).

The IMP wetting layer process includes applying sufficient DC power to a target to sputter metal atoms of the target towards a substrate holder (pedestal) below the topography wherein the sputtered metal atoms comprise titanium (Table I-continued on column 13); applying sufficient RF power to an RF induction coil between the target and pedestal to ionize at least a portion of the metal ions sputtered from the target (Table I-

Art Unit: 1745

continued on column 13 and col. 3, ll. 4-25), and applying sufficient bias to the pedestal to direct the ionized metal atoms towards the dielectric layer in a direction substantially normal to the dielectric layer (Table I-continued on column 13 as applied to claim 7).

The bulk metal layer comprises aluminum and the wetting layer comprises titanium (Table I continued on column 13 as applied to claim 11).

Kim discloses a method for fabricating a metallization structure comprising: etching contacts in the dielectric layer (col. 1, ll. 20-22, col. 7, ll. 29-38 and Fig. 1), IMP depositing a wetting layer of titanium (Table 1) and sputtering depositing a bulk metal layer on the wetting layer (col. 8, ll. 38-42 as applied to claim 30).

### ***Response to Arguments***

6. Applicant's arguments in the amendment received June 14, 2002 have been considered but are moot in view of the new ground(s) of rejection.

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of U.S. patent No. 6,045,666 (Satitpunwaycha).

Art Unit: 1745

The teachings of claim 1 have been discussed above and are incorporated herein.

The difference between instant claim 2 and Kim is that Kim does not disclose depositing an insulating layer over the bulk metal layer.

Modern semiconductor integrated circuits usually involve multiple layers separated by dielectric (insulating) layers, such as of silicon dioxide or silica, often referred to simply as an oxide layer, although other materials are being considered for the dielectric. The layers are electrically interconnected by holes penetrating the intervening oxide layer which contact some underlying conductive feature. After the holes are etched, they are filled with a metal, such as aluminum, to electrically connect the bottom layer with the top layer. The generic structure is referred to as a plug. If the underlying layer is silicon or polysilicon, the plug is a contact. If the underlying layer is a metal, the plug is a via (col. 1, lines 20-32 of Satitpunwaycha).

The motivation for forming an insulating layer atop the metal layer is that it would have been used in the manufacture of IC having multiple layers.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Kim by forming an insulation layer atop the metal layer since it would have generated an IC having multiple layers.

9. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of U.S. patent No. 6,217,721 (Xu-721).

The teachings of claim 1 have been discussed above and are incorporated herein.

Art Unit: 1745

The differences not yet discussed is the cavity comprising a via in the dielectric layer extending to a conductive region of the topography (claim 8).

Xu-721 shows forming an underlying metal conductive layer 310 underneath the dielectric layer and across the surface of the substrate (Fig. 17).

The motivation for providing a conductive material in the manner shown by XU-721 is that it provides improved bonding of the titanium layer(s) to the bottom of the contact.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Kim by providing a conductive layer of aluminum at the bottom of the contact as taught by Xu-721 since it would have improved the bonding of the titanium layer(s) to the bottom of the contact.

10. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of U.S. patent No. 5,371,042 (Ong).

The teachings of claim 1 have been discussed above and are incorporated herein.

The differences not yet discussed are of precleaning the topography prior to IMP depositing the wetting layer (claim 9) and of removing an upper portion of the dielectric layer to formed tapered cavity walls (claim 10).

With respect to claim 9:



Art Unit: 1745

In a first process step, the contact openings are cleaned and the upper corner faceted. For openings in silicon oxide layers, sputter etching about 300 angstroms of the layer in argon plasma both removes the native oxide from the bottom of the contacts or vias and facets the corners of the openings, ensuring good intermetallic contacts as well as complete filling of the openings and the absence of any voids in the center of the filled openings. FIG. 2 illustrates a faceted contact opening (col. 3, ll. 3-11 and Fig. 2).

The motivation for providing a precleaning step is to remove contaminants from the surface upon which material is to be deposited and improve the adhesion of the deposited films to the dielectric or insulating layer.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Kim by providing a precleaning step since it would have removed contaminants from the surface upon which material is to be deposited and improved the adhesion of the deposited films to the dielectric or insulating layer.

With respect to claim 10:

In a first process step, the contact openings are cleaned and the upper corner faceted. For openings in silicon oxide layers, sputter etching about 300 angstroms of the layer in argon plasma both removes the native oxide from the bottom of the contacts or vias and facets the corners of the openings, ensuring good intermetallic contacts as well as complete filling of the openings and the absence of any voids in the center of the filled openings. FIG. 2 illustrates a faceted contact opening (col. 3, ll. 3-11 and Fig. 2).

Art Unit: 1745

The motivation for forming facets in the upper portion of the dielectric or insulating layer is to ensure good intermetallic contact and reduce and/or eliminate the formation of voids by providing complete filling of the contacts.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Kim by forming facets in the upper portion of the dielectric or insulating layer since it would have ensured good intermetallic contact and reduced and/or eliminated the formation of voids by having provided complete filling of the contacts.

#### ***Response to Arguments***

11. Applicant's arguments in the amendment received June 14, 2002 have been considered but are moot in view of the new ground(s) of rejection.

#### ***Allowable Subject Matter***

12. Claims 12-18 and 22-23 are allowed as set forth in the previous office action, incorporated herein.

#### ***Conclusion***

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

Art Unit: 1745

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregg Cantelmo whose telephone number is (703) 305-0635. The examiner can normally be reached on Monday through Thursday from 8:00 a.m. to 5:30 p.m. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan, can be reached on (703) 308-2383. FAX communications should be sent to the appropriate FAX number: (703) 872-9311 for After Final Responses only; (703) 872-9310 for all other responses. FAXES received after 4 p.m. will not be processed until the following business day. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.


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Application/Control Number: 09/476,669  
Art Unit: 1745

Page 11

August 27, 2002

  
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Technology Center 1700